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ABSTRACT

Using a $274,300 grant from the National Science Foundation, Miami-Dade Community College augmented its Mathematics Learning Center with a multi-media, computer-assisted program of individualized instruction designed to efficiently aid the growing number of students with mathematics deficiencies. This program has three interlocking components. The first, an assessment and placement system, tests the student's knowledge of the subject he/she wishes to pursue at the Learning Center (e.g., arithmetic, introductory algebra, intermediate algebra, or trigonometry) and determines the student's preference for one of four available learning modes: audio-tutorial materials, programmed materials, slide/tape materials, or work-texts. The second component, the instructional system, utilizes these modes to provide the student with a sequential series of learning units. The student must pass a computer-graded test at the end of each unit before going on to the next. Comprehensive midterm and final examinations are also required. The third component, a computerized system of evaluation and management, utilizes a computer program to write an introductory letter to the student explaining the instructional system and to provide a detailed analysis of examination performance. By having the computer handle the clerical work, the Learning Center staff can help more students more extensively than before. (JP)

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# TECHNOLOGY IN TEACHING MATHEMATICS: A COMPUTER MANAGED, MULTIMEDIA MATHEMATICS LEARNING CENTER

by

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A Presentation To

The 57th Annual Meeting of the

National Council of Teachers of Mathematics

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## THE PROBLEM

It is the purpose of the Community College to provide to every adult an opportunity to seek a College education. From this objective has evolved the so-called "Open Door Policy". For example, at Miami-Dade Community College, located in the State of Florida, every person over eighteen years of age is permitted to enroll in the curriculum of his/her choice. The enrollee need not pass an entrance exam. He/she need not have a high school diploma or even have attended High School. The reader can well imagine the range of academic abilities that is manifested by students admitted in this manner. To make matters worse, results of national, state, and local testing in the area of mathematics indicate that entering students in general know less mathematics today than at any time in the history of such testing programs.

The problem to be addressed in this paper is the following: Is it possible to provide a program of instruction in mathematics flexible enough to accommodate a wide range of deficiencies at an affordable cost to the taxpayers of Florida? That is, since most occupations demand some level of competence in mathematics, how can we make sure that every student has a fair chance at a college education?

## THE SOLUTION

The College's solution to this problem of ability range was to offer a full sequence of courses in mathematics from Arithmetic through Differential Equations, Linear Algebra, and Modern Algebra. On the whole, this has proven to be an inadequate solution in that it has failed to overcome severe deficiencies in the mathematical background of the vast majority of students. Also, there seemed to be a lack of motivation on the part of a great number of students. In short, too many students were failing to complete the mathematics required for their curricula.

In an effort to reduce failure, the author established a Mathematics Learning Center at the New World Center Campus of Miami-Dade. The Learning Center originally had and continues to have three objectives. The first objective was to provide a place where students pursuing mathematics from remedial to advanced levels could seek help. The second objective was to provide a form of instruction in lieu of the classroom situation. The third objective was to provide a place where those interested in mathematics be they instructor or student, could gather to discuss mathematics.

The Mathematics Learning Center was so successful that in a matter of two years far more students sought help than could be accommodated by the assigned personnel. Consequently, the author wrote a proposal to the C.A.U.S.E. program of the National Science Foundation for a project which would make the Center operation more efficient and more effective and hence able to serve greater numbers of students.

## THE PROJECT

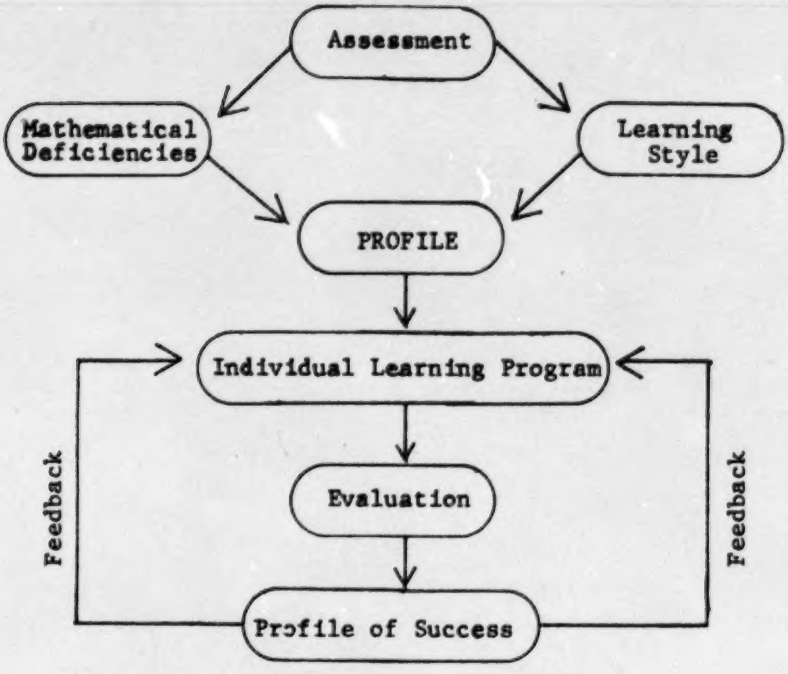
### Objectives

On June 15, 1976, a three year, $274,300 grant was awarded by the National Science Foundation. Miami-Dade Community College contributed an additional $118,281 to complete funding for the project which had the following objectives:

a) To incorporate the present body of knowledge concerned with the psychology of learning into a comprehensive system of instruction so as to maximize the probability of student success

b) To use the modern computer to manage the day-to-day record keeping of the instructional process and to administer as much reinforcement and feedback as possible.

The resulting program of instruction was composed of the following interphased parts: 1) A system of assessment and placement, 2) A system of multimedia instruction, and 3) A computerized system of evaluation and management. See the diagram below.




It is to be noted from the above diagram that every effort was made to individualize instruction according to the needs of the student. Each of the components of the program are discussed below.

A System of Assessment and Placement

The assessment and placement system combines the results of two paper and pencil inventories. The first inventory is a multiple choice mathematics test appropriate to the course which the student has indicated he/she wishes to pursue. The second inventory is the Canfield-Lafferty Learning Styles Inventory designed to determine an individual's preferred way of learning. Through a set of decision rules programmed into a computer, the student is assigned to one of four modes of individualized instruction.

A System of Multimedia Instruction

The assessment and placement system tries for a best fit between the student's professed ideal learning style (profile) and an available mode of instruction for each of four courses: arithmetic, introductory algebra, inter-

mediate algebra, and trigonometry. The four modes of instruction for each course consist of one or more of the following: audio-tutorial materials, programmed materials, tape/slide materials, and work-texts combined with video or audio tapes. All of the preceding materials are graded as to reading level. The Auto-tutor (a branched programmed teaching machine) and the SRA Skills Kit are used to give additional practice to students who need more work. A paraprofessional and/or student peer teacher is always available to answer questions concerning the content of instructional materials.

A Computerized System of Evaluation and Management

Each course taught in this program is divided into twelve units or modules. The student is required to take a test after each unit. In addition, he/she is expected to take a comprehensive mid-term exam and a comprehensive final exam. All exams are multiple choice so that they may be scored by computer. A student must meet criterion on each of the unit tests before he/she is allowed to go to the next unit. If criterion, eight out of ten, is not met on the first attempt to pass a unit test, the student must review the material missed and do extra problems before he/she is allowed to take a retest which is a different version of the first test. The criterion for the retest is raised to nine out of ten.

If a student is still not successful, he/she is assigned to a tutor who takes over supervision of his/her learning program until mastery is demonstrated for the material of that particular unit. Upon certification of success by the tutor, the student re-enters the mainstream of the computer system.

Learning and evaluation is managed by a computer using the College's RSVP, Response System with Variable Prescription, computer program. RSVP begins by writing the student an introductory "letter" outlining the instructional system and detailing what is to be expected. It also delineates the individual's program of study by listing the appropriate educational objectives, by list-

ing the materials to be studied, and by specifying how far to proceed in the designated material before a test is to be taken. The student works at his/her own pace with a gentle reminder that by specific dates a certain number of units should be completed. When he/she is ready, a test is taken. The test is scored by computer and the student receives a printed analysis of his/her test including each of the following: 1) the score on the test, 2) which problems were missed, 3) what they covered, and 4) where he/she may go in the materials to find the particular topic. Review of all missed items is recommended before the student proceeds. A record of each student's progress is kept by the computer.

## ORIGINALITY AND SIGNIFICANCE

The Computer Managed, Multimedia Mathematics Learning Center described in this paper is the only one known to this author. It is unique in its attempt to empirically apply the psychology of learning to mathematics. By harnessing the ability of the computer to handle clerical work, this project allows the Learning Center staff to help more students more extensively than before.

If the program of evaluation in progress indicates that this program is as successful as normal classroom instruction, there is the possibility of serving more students at less cost. If the program is more successful than the normal classroom, then, perhaps we have discovered a better way to help students learn. In any event, the self pacing aspect of the program has allowed able students to save time by completing several courses during one semester. And more importantly, it has allowed slower students who might have failed during one semester to complete their studies successfully.

## CREDITS

The above project could not have been completed without the able and devoted work of Mr. John Lester, mathematician, Mr. Steven Walfish, research and systems analyst, and Mrs. Heidi Bergdorf, secretary. All inquiries concerning similar funding should be directed to the C.A.U.S.E. Program, Division of Science Education Resources Improvement, National Science Foundation, Washington, D.C. 20550.

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